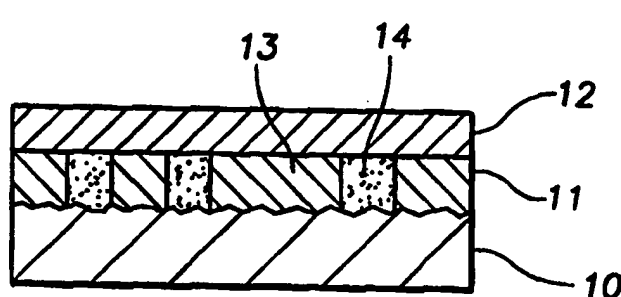


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(54) Title: LASER ABLATIVE LITHOGRAPHIC PRINTING PLATE WITH DEBRIS ENTRAINMENT AND PROCESS OF USE		
		
(57) Abstract <p>A lithographic printing plate imageable by laser ablation, where debris from the ablated areas (14) is entrained by a non-strippable protective layer (12) removable by dissolution treatment with aqueous solutions thereby preventing the debris from depositing on the imaging optics. The substrate (10) is hydrophilic and may be anodized aluminum and the non-water soluble laser ablatable layer (11) is imaged using a laser to form unablated areas (13) and ablated areas (14). The debris from the ablation process (14) is removed with the water soluble non-strippable layer (12) by treatment using an aqueous solution.</p>		

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LASER ABLATIVE LITHOGRAPHIC PRINTING PLATE WITH DEBRIS ENTRAINMENT AND PROCESS OF USE

Field of the Invention

This is a continuation-in-part of Serial No. 09/023,912 filed February 13, 1998
5 which is incorporated herein by reference.

The present invention relates to a method for eliminating the accumulation of ablative residue on the components of a laser imaging device. More particularly, the invention relates to the use of a laser transparent, or water-soluble, non-strippable top coating over an ablatable layer such that when ablatively imaged with a laser, the ablative residue is contained
10 by the top coating and prevented from accumulating on the components of the laser imaging device.

Background of the Invention

Computer-to-plate imaging systems use a modulated infrared laser to image printing plates which occurs by selective ablation of an ablatable layer. An imaged printing plate
15 thus contains an image where the laser has not struck and the ablatable layer remains adhered to the plate and background areas where the laser has struck the plate and the ablatable layer is removed.

A by-product of the ablation process is a residue or dust that is generated as a result of the ablation process. The accumulation of residue on the mirrors and optics of the laser
20 imaging device can have adverse effects on its performance.

A vacuum device has been fitted into an imager which follows along during the imaging process. While this may capture a significant amount of residue, it is not sufficient to prevent the residue from depositing on the optics of the imager.

Maintaining positive air pressure or controlling the direction of air flow have also
25 been tried. These means do not completely eliminate the problem and undesirably introduce residue into other regions of the imager and the surrounding environment.

Some ablatable layers have been provided with a cover sheet of polyester or the like. While this approach can contain ablative residue, it suffers from other drawbacks. The index of refraction of a cover sheet can cause a distortion of the image on the plate. More

significantly, the cover sheet, which will have some amount of ablative residue adhered to it, must be removed before the plate can be used.

A printing plate for use in a non-ablative imaging process is described in U.S. Patent No. 5,674,658. The printing plate includes a support having a hydrophilic surface, an
5 oleophilic imaging layer and an integral stripping layer over the imaging layer. Imagewise exposure with an infrared laser causes the exposed areas to interact with the hydrophilic surface and bind thereto to form an image. The stripping layer, which is transparent to infrared radiation, is peeled away from the imaging layer with the non-exposed, background areas of the imaging layer adhered thereto. The stripping layer may be made of polyvinylalcohol.

10 U.S. Patent Nos. 5,677,108 and 5,677,110 to Chia et al. disclose providing a printing plate precursor element having a hydrophilic substrate, a photohardenable photoresist and a layer of polymeric protective overcoat, such as polyvinyl alcohol; imagewise exposing the precursor element to actinic radiation through the photoresist and overcoat layers to create a latent image in the photoresist layer and mounting the precursor element onto a lithographic
15 printing press. Printing fluid removes the overcoat and develops the latent image while the precursor element is on press. The Chia et al. precursor element is not laser imageable.

Published EP Application 844 080 describes a water soluble protective layer on an infrared laser plate having an oleophilic substrate and a hydrophilic metallic inorganic coating. The use of the protective layer on a coated plate to be etched with a CO₂ laser is
20 suggested. However, it is believed that the CO₂ laser also removes the protective layer when etching the underlying coating. The use of the protective layer with an Argon laser is also suggested. However, the Argon laser causes evaporation removal which would be prevented by the protective layer.

The present invention prevents ablation residue from depositing on the interior
25 of the imaging device and entering the environment without using a cover sheet or strippable coating.

Summary of the present invention

The present invention provides a laser imageable printing plate having a substrate, an ablatable layer, and a laser transparent, solvent soluble, non-strippable top coating which

entraps ablated portions of the ablatable layer. The ablatable layer is insoluble in the solvent for the top coating.

Preferably, the top coating is water-soluble and the ablatable layer is water-insoluble and oleophilic. The top coating is made of a film forming material that is transparent
5 to the imaging radiation and non-strippable, that is, it cannot be physically stripped from the plate but can be removed with a solvent, e.g. water.

The preferred substrate is a hydrophilic metallic substrate, preferably anodized aluminum, which has been treated to render it imageable by an infrared laser and capable of causing laser ablation of the ablatable layer.

10 During the imaging process, portions of the ablatable layer are converted to discontinuous residue or dust, but the top coating remains sufficiently intact so as to prevent the expulsion of any of the residue into the imager or the surrounding environment. The plate is subsequently washed with a solvent that will not dissolve the underlying image to simultaneously remove the top coating and the residue from the imaged areas.

15 Brief Description of the Drawings

Figure 1 is a cross-section of a printing plate comprising a substrate (10), an ablatable layer (11) and a top coating (12) useful in the invention;

Figure 2 is a cross-section of a printing plate according to the invention showing the ablated non-image (14) trapped between the substrate (10) and the top coating (12) as well
20 as the image (13); and

Figure 3 is a cross section of a printing plate according to the invention with the ablated non-image and top coating removed.

Detailed Description of the Invention

The present invention is directed to printing plates having an ablatable layer
25 (11) on a substrate carrier (10) and a top coating (12) overlying the ablatable layer. Typical substrates (10) may be for example, aluminum, polyester, or polyester laminated to aluminum. A preferred substrate is, for example, an aluminum sheet which has been surface roughened (grained) and anodized by methods known to those skilled in the art of processing aluminum printing plate substrates. One method for graining is disclosed in U.S. Patent No. 4,183,788

hereby incorporated by reference. U.S. Patent Re 29,754 discloses a preferred method of anodizing. The choice of substrates used is not critical to the invention.

The preferred metal substrate is hydrophilic and is treated such that the surface is capable of being visibly imaged by selective writing with an infrared laser. A preferred
5 treatment for this purpose is rotary brush graining. The phrase "rotary brush graining" is intended to refer to any process using axially rotating brushes that tangentially contact a surface to be grained in the presence of a slurry containing particulate material such as alumina, silica and the like. The phrase also includes equivalent processes that produce the same result.

The treated surface is coated with an ablatable coating which is transparent to
10 imaging infrared laser radiation. Selective exposure to infrared laser radiation ablates this coating in the laser exposed areas as a result of the absorption of infrared radiation by the treated metal surface. The coated substrate can be imaged in a computer-to-plate infrared laser imaging device. Depending on the specific coating and substrate selection, the imaged substrate can be used in a conventional lithographic printing process or in a dryographic printing process.

15 The preferred metal substrate is aluminum which is preferably anodized after being treated to render the substrate imageable by an infrared laser. Anodized aluminum may optionally be post treated with sodium silicate, polyvinylphosphonic acid or the like to enhance the hydrophilic nature of the non-image areas.

The ablatable coating itself does not absorb ablative infrared laser radiation, since
20 it is transparent to it. The imaging infrared laser radiation passes through the coating and is absorbed by the treated metal substrate. The coating in the laser imaged areas ablates as a result of the incident infrared energy captured by the treated metal substrate. The coating in the areas not exposed to the imaging laser radiation remains adhered to the plate.

The preferred substrate serves three functions. First, it carries an ablatable
25 coating and the top coating. Secondly it is capable of absorbing infrared laser radiation to ablate the coating. Lastly, it becomes the printing plate itself where the laser ablated areas function as the image or the background depending on the choice of coating and the mode of printing. i.e. lithographic or dryographic. Because the substrate itself causes laser ablation of the coating, which functions as the image or background after laser imaging, no intermediate layer or coating

is required to promote or cause ablation to take place.

The amount of rotary brush graining required to impart the ability to be imaged by an infrared laser can be determined empirically. For example, three samples were prepared representing different degrees of rotary brush graining. The same brush graining unit and
5 brushes were used for each sample. The brush graining stand contained eight brushes, each 14 inches in diameter. The brush filaments were 2 inch long nylon. The brushes were rotated axially at 750 rpm. The slurry contained 33% unfused platy alumina. An aluminum web was passed through the brush graining unit at a rate of 80 feet per minute. A sample was removed and identified as 1P (one pass). The already grained web was passed through the brush graining
10 unit at the same rate of 80 feet per minute a second time. A sample was removed and identified as 2P (two pass). The twice grained aluminum web was again passed through the brush graining unit at the same rate for a third time. A final sample was removed and identified as 3P (three pass).

All three plate samples were subjected to infrared laser imaging on a Gerber
15 Crescent 42T Plate Image Setter manufactured by Gerber Scientific of South Windsor, Connecticut. The imaging conditions were the same for each sample. Sample 1P had an image which was barely visible. Sample 2P had move visible image, but the contrast was still rather weak. Sample 3P had a strong vivid image. Although the three samples were found to have similar topographies as characterized by conventional stylus profiling and roughness
20 measurement techniques, the ability to be imaged by the laser is significantly different for the samples.

While not being bound by any particular theory, it appears that extensive embedment of particles during the graining process gives rise to the unique character of the imageable surface. Rotary brush graining results in a surface where multiple particles (e.g.,
25 calcined alumina) become embedded within the surface of the sheet, with most being covered over by a skin of the metal as a result of the extensive roughening. The particles have a low thermal conductivity relative to the metal. Thus, hard (relative to the metal substrate) particles with low thermal conductivity, especially hard metal oxide particles, are preferred for use in the present invention. These embedded particles within the metal matrix make for a very circuitous

and thus less efficient path for heat dissipation. The energy captured at the surface cannot be transferred efficiently to the substrate via the thin cross sections by which thermal continuity to the bulk of the substrate metal sheet is maintained. This results in a temperature rise at the surface of the grained metal sheet which is sufficient to cause some amount of localized melting
5 of the aluminum within the surface. While rotary brush graining has been shown to be an efficient method for producing these surfaces, other equivalent methods such as high pressure rolling, grit blasting, ball graining, or the like, which give rise to a metal surface with a relatively high degree of embedded particulate material may also be used.

Not all graining methods are suitable for producing a surface which can be
10 imaged with an infrared laser. For example, graining techniques that do not embed particles such as chemical or electrochemical graining, known to produce suitable lithographic surfaces, do not produce a surface which is imageable by an infrared laser. However, these techniques can be employed for special purposes provided the substrate is subsequently rotary brush grained.

Rotary brush graining typically increases surface roughness. However, roughness
15 of the substrate need not be increased in order to make it laser imageable. For example, it is possible to emboss or electrochemically grain a substrate to produce a coarsely roughened surface, which itself is not laser imageable. Rotary brush graining as described herein will render the substrate laser imageable and may also reduce surface roughness as measured, for example, by a stylus type profiling instrument. Similarly, blasting with very fine particles might
20 reduce the surface roughness of a substrate having a more coarse initial topography. What is required is a treatment which renders the substrate imageable with an infrared laser, but the surface roughness may be increased or decreased as a result of rotary brush graining or equivalent treatment as described herein.

Subsequent to the brush graining process, treatment with harsh chemicals may
25 cause the surface to lose its ability to be imaged by lasers. For example, etching with sodium hydroxide, as disclosed in U.S. Patent 4,731,317 alters the surface such that it cannot be so imaged. Additionally, excessive anodizing in electrolytes such as sulfuric acid or phosphoric acid can alter the surface so that it is no longer imageable. It is believed that these types of treatments remove the embedded particles and thus alter the efficiency with which the thermal

energy is conducted from the surface into the substrate sheet.

It is possible to anodize the brush grained surface and retain the ability to image the surface with infrared lasers. Anodizing in sulfuric acid at low temperatures with relatively low oxide coating weights is effective in producing a surface which can be laser imaged and yet
5 have the hardness and durability needed for printing. An anodic oxide thickness of about one micron or less, preferably about 0.5 microns, is most suitable.

Although aluminum is the preferred substrate, other metals can be rotary brush grained as described herein, coated with an ablatable coating and top coated, and selectively imaged with an infrared laser such that the coating is ablated in the laser written areas. Suitable
10 metals include zinc, tin, iron, steel and alloys thereof. Laminates of metals can also be used such as tin, zinc, lead and alloys thereof clad or plated onto steel. A rotary brush grained steel surface will absorb infrared laser radiation to selectively ablate a coating as described herein but is not itself imaged as is the case with aluminum and other metals.

In a preferred embodiment, the substrate is prepared on a continuous coil
15 anodizing line. The aluminum web is first subjected to a cleaning or degreasing process to remove milling oil residue from the surface. These processes are well known in the art of preparing aluminum surfaces for subsequent anodization. The aluminum web is rinsed in water after the cleaning step. It is next subjected to a rotary brush graining process using a series of axially rotating brushes that tangentially contact the web in the presence of a slurry comprising
20 unfused platy alumina having a particle size of from 2 to 5 microns up to about 10 microns. As described previously, three passes through an eight brush grainer unit at 80 feet per minute results in a surface which can be laser imaged or can cause an ablatable coating to be ablated from the surface. An equivalent result can be obtained either by a single pass through the eight brush grainer at a throughput speed of approximately 27 feet per minute, or by a single pass
25 through a 24 brush grainer at 80 feet per minute. Although subsequent anodizing is preferred, the as-grained aluminum surface itself is also imageable and can cause a coating thereon to ablate when imaged by an infrared laser. A useful method for graining is as taught in U.S. Patent 4,183,788 to Fromson.

After graining, the aluminum web is rinsed in water and anodized by methods

well understood in the art. The electrolyte can be, for example, sulfuric acid or phosphoric acid. Sulfuric acid is preferred since it allows for oxide formation at lower dissolution rates. The anodizing is further preferentially carried out at relatively lower temperatures to further minimize the redissolution of the anodic oxide coating with the added benefit of producing a harder oxide layer than anodizing processes at higher electrolyte temperatures. Preferred oxide coating weights are in the range of 0.1 to 3.0 milligrams per square inch, more preferably from about 0.2 to 0.8 milligrams per square inch. U.S. Patent Re 29,754 to Fromson discloses a preferred method for anodizing.

The ablatable layer, which is preferably oleophilic, has a different affinity for ink and fountain solution than that of the substrate, which is preferably hydrophilic. The ablatable layer is preferably water insoluble so that it will not be removed along with the water soluble top coating and the ablated dust upon exposure to an aqueous solvent. Examples of suitable ablatable layers include the nitrocellulose-based materials which incorporate materials

that are absorptive in the near infrared region, e.g. as disclosed in United States Patent No. 5,493,971, hereby incorporated by reference. Other suitable coatings include certain phenolic polymers or silicone resins. The ablation of the coating seems to occur without any evidence of burning, charring or any change other than that it is converted to a fine dust or
5 residue.

The ablatable coating can be non-light sensitive, such as phenylmethysiloxanes, or light sensitive, such as positive active coatings based on phenolic resins. Such positive acting coatings are well known in the art and have been found to readily ablate with an infrared laser when applied to a substrate of the present invention. The laser removes background areas
10 leaving the phenylmethysiloxane or phenolic resin in the areas where the plate was not laser imaged.

Positive acting coatings can also be used with a second coating which is transparent to infrared laser radiation but may or may not itself be ablatable from the substrate. The non-ablatable, non-stripable top coating is applied to the second coating. Thus, if it is
15 desired to present a special surface for a particular application which can only be provided by a non-ablatable coating, an ablatable undercoating on the substrate with a top coating of the non-ablatable coating will enable selective laser ablation of both layers.

For example, in waterless or dryographic printing, the background must be low in surface energy so as to repel the printing fluid which is carried by the image areas of the plate.
20 Cross-linked polysiloxane polymers such as described in Example 12 and 13 of copending application Serial No. 09/079,735 filed May 15, 1998 have a sufficiently low surface energy to be used as the non-image or background of a dryographic plate but cannot be ablated from the substrate of the invention. Second coating a cross-linked polysiloxane coating onto an ablatable positive working coating on the substrate enables laser ablation of both coatings simultaneously
25 from image areas on the substrate while the ablated dust is retrained by the top coating. Thus, a positive working coating is used to form a negative working plate and is the means by which an otherwise non-ablatable coating can be selectively removed from the substrate of the invention.

Phenolic resins are known to be useful as the image forming area on a printing

plate, and can further be heat-set to provide a durable image capable of very long press runs. Examples of phenolic resins useful in the practice of this invention, such as Novolac or resole resins, are described in Chapter XV of "Synthetic Resins in Coatings," H.P. Preuss, Noyes Development Corporation (1965), Pearl River, New York.

5 The ablatable coating should be as thin as possible but still adequately cover the substrate to provide a durable image for printing. Coating weights in the range of about 50 to about 500 milligrams per square foot can be used, but it is preferable to work in the range of about 100 to 200 milligrams per square foot. Thicker coatings require more time and energy to ablate. This is an important factor in newspaper publishing industry, where large numbers of
10 plates must be prepared within a tight time constraint. Reducing the coating weight from 200 milligrams per square foot to 150 milligrams per square foot can result in a reduction in laser exposure time of about 15%. A second coating, when used, is preferably about the same thickness as the ablatable coating.

 When using a positive working light sensitive phenolic resin coating, it is
15 preferred, after ablation and removing the top coating with the ablation residue, to blanket expose the laser imaged plate with ultraviolet light sufficient to solubilize any coating residue which remains in the background. This alleviates any undesirable ink pick-up in the non-image areas of the plate on press. A short exposure of about 25 millijoules per square centimeter will solubilize any resin in the background, which is then removed, for example, with an alkaline
20 cleaning solution. This blanket exposure represents about 8 to 10% of the total energy normally used to expose a positive resin. A thin skin of the resin coating will also be removed from the image area, but these losses are on the order of 4% and are tolerable. The coating still retains it's integrity in the printing process.

 Imaging of the ablatable layer is most typically done using a laser emitting in
25 the near infrared region. Such laser imaging devices are commercially available. An example of a suitable laser is the Crescent 42T, available from Gerber Systems of South Windsor, Connecticut. This unit presently employs a 10 watt YAG laser emitting at 1064 nanometers.

 The non-ablatable, non-strippable top coating (12) is transparent in the frequency of the imaging radiation, a film former, and retains sufficient integrity during the

ablation process to prevent the expulsion of the ablative residue when the underlying ablative coating is imaged. The top coating must also be removable upon exposure to solvent, e.g. water. Typically, the top coating, along with any ablated dust, will be removed by washing with a solution in which the ablatable layer is insoluble.

5 Suitable top coating materials include non-ablatable, hydrophilic materials such as hydrophilic polymers, hydrophilic gums, and mixtures thereof. Preferred is a gas impermeable top coating comprising polyvinyl alcohol (PVA).

 The non-ablatable top coating can be applied to the printing plate by any art known technique, e.g. extrusion, dipping, spray coating, etc. The coating will be applied as
10 necessary to reach the desired weight and/or thickness. The appropriate thickness will depend on the specific top coating material, and can be determined empirically. For polyvinyl alcohol, a range of about 10 to about 50 mg / sq. ft. is optimum.

 A preferred embodiment of the invention is set forth in the Example below. This example is given by way of illustration only, and is not construed as limiting the scope or spirit
15 of the invention. Many modifications will become apparent to those skilled in the art, and such embodiments are meant to be encompassed by the claims appended hereto.

Detailed Description of the Preferred Embodiment

Example 1:

 An aluminum substrate is degreased, brush grained, and anodized in web form.
20 The graining is accomplished using a series of eight cylindrical nylon brushes rotating at 750 RPM. The speed of the web was 25 ft. / min. The graining medium was unfused aluminum oxide (calcined alumina). After graining, the web was anodized in sulfuric acid to an oxide coat weight of 0.5 mg / sq. ft.; thereafter the web is rinsed, dried, and recoiled.

 The above grained and anodized coil is then placed on a web coating line
25 equipped with two extrusion coating heads. A positive working, UV sensitive, coating is applied at a dry coating weight of 200 mg / sq. ft.

The coating formula was as follows:

	Arcosole PM	42.86%
	Ethanol	21.34%
	Positive Sensitizer	9.26%
5	Cresol-formaldehyde resin	20.70%
	t-Butylphenolformaldehyde resin	5.00%
	Dye	0.76%
	BYK 344	<u>0.08%</u>
		100.00%

10

A second coating was applied in series using the second extrusion head. The coating was applied a dry coating weight of 10 mg / sq. ft.

The coating formulation was as follows:

	Water	77.66 g
15	Airvol-603(22%)	3.25 g
	Dow fax 3B2	0.19 g
	Ludox	1.40 g
	Methanol	15.00 g
	PM Ether	2.50 g

20

The coated product was dried and cut into single page sheets. The coated product was then place in a Gerber 42T Thermal Plate Imager. The 42T was equipped with a 10 watt YAG Laser that delivered 7 watts of power to the plate surface. The laser scanned the plates at 150 Hz, 2540 dpi, with spot size of 12 microns. Scanning was done in the positive mode i.e. background removed.

25

It was noted after the plates were removed from the Thermal Plate Imager that no dust or debris was found inside the cavity of the imager. Therefore, none of the optics nor the precision moving parts were contaminated with laser ablated dust. The imaged plates were developed in a modified positive processor. The modification consisted of a rinse / brush section followed by a UV exposure of 25 m / cm prior to entering the positive processor. The

30

positive processor's developing station contained a standard developer consisting of an alkali metal silicate and sodium hydroxide. The pH was approximately 12.5. Following development, the plates were rinsed, gummed, and dried. The processing speed was set at 5 ft. / min.

The processed plate was placed on a duplicator press producing clean, high-quality
5 copies.

CLAIMS

It is claimed:

1. In a process for laser imaging a printing plate, the improvement for reducing laser ablated residue comprising:

providing a laser imageable printing plate comprising a substrate, a non-water soluble ablatable layer, and a laser transparent, water soluble, non-strippable top coating, said substrate being imageable by an infrared laser and capable of causing infrared laser ablation of said ablatable layer;

selectively ablating said ablatable layer with an infrared laser and entrapping ablated residue under said top coating; and

removing said top coating and the ablated residue with an aqueous solvent.

2. Laser imageable printing plate comprising a substrate, a non-water soluble ablatable layer, and a laser transparent, water soluble, non-strippable top coating which is capable of entrapping ablated portions of the ablatable layer, said substrate being imageable by an infrared laser and capable of causing infrared laser ablation of said ablatable layer.

3. Printing plate of claim 2 wherein said top coating is selected from the group consisting of hydrophilic polymers, hydrophilic gums and mixtures thereof.

4. Printing plate of claim 3 wherein said hydrophilic polymer is polyvinyl alcohol.

5. Printing plate of claim 2, wherein said substrate is anodized aluminum.

6. Process for preparing a laser imageable printing plate having a laser

ablatable layer comprising coating the laser ablatable layer on a substrate with a laser transparent, water soluble, non-strippable top coating, said substrate being imageable by an infrared laser and capable of causing infrared laser ablation of said ablatable layer.

7. Laser imageable printing plate comprising a substrate, a non-water soluble ablatable layer and a laser transparent, solvent soluble, non-strippable top coating which entraps ablated portions of the ablatable layer, wherein said ablatable layer is insoluble in said solvent, said substrate being imageable by an infrared laser and capable of causing infrared laser ablation of said ablatable layer.

8. In a process for laser imaging a printing plate, the improvement for reducing laser ablated residue comprising:

providing a laser imageable printing plate comprising a metallic substrate, a non-water soluble ablatable layer, and a laser transparent, water soluble, non-strippable top coating, said substrate being capable of causing infrared laser ablation of said ablatable layer;

selectively ablating said ablatable layer with an infrared laser and entrapping ablated residue under said top coating; and

removing said top coating and the ablated residue with an aqueous solvent.

9. Laser imageable printing plate comprising a metallic substrate, a non-water soluble ablatable layer, and a laser transparent, water soluble, non-strippable top coating which is capable of entrapping ablated portions of the ablatable layer, said substrate being capable of causing infrared laser ablation of said ablatable layer.

10. Printing plate of claim 9, wherein said substrate is anodized aluminum.

FIG. 1

1/1

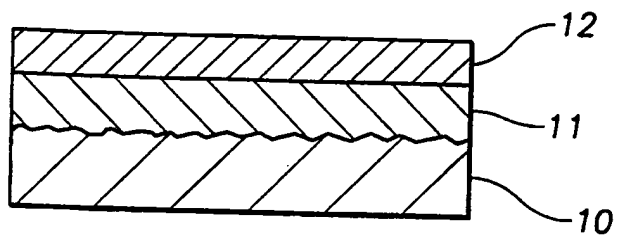


FIG. 2

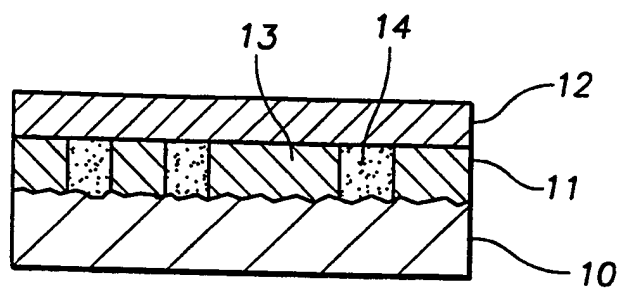
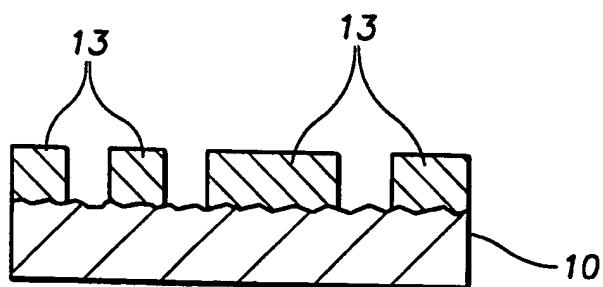


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/00970

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : B41C 1/00; B41N 1/14; G03F 7/11

US CL : 430/200, 201, 302, 306, 950, 945; 101/457, 467

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 430/200, 201, 302, 306, 950, 945; 101/457, 467

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P ----- Y,P	EP 0844080 A (PRESSTEK, INC) 27 May 1998, Entire document, particularly claims 1,6 and 13.	2,3,7 ----- 1-3, 6-9
Y	US 5,674,658 A (BURBERRY et al.) 07 October 1997, Entire document, particularly example 49-52.	1-10
Y	US 5,677,108 A (CHIA et al.) 14 October 1997, entire document, particularly col. 7, line 50 to col. 8. line 28.	1-10
Y	Shapiro, Charles, ed, The Lithographer's Manual, (1970), pp. 17:7, definition of fountain solution.	1-10

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
B earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

25 FEBRUARY 1999

Date of mailing of the international search report

15 APR 1999

Name and mailing address of the ISA/US
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/00970

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P ----- Y,P	CA 2,221,922 A (PRESSTEK, INC) 20 February 1998, entire document, particularly claims 1,6,13.	2,3,7 ----- 1-3,6-9
Y	US 5,506,086 A (VAN ZOEREN) 09 April 1996, entire document, particularly col 11, line 25 to col. 13, line 50.	1-10